CLAIMS

1. A displacement sensor comprising a sensor head and a controller either integrally or separately;

the sensor head comprising:

a measurement light emitting optical system for emitting measurement light onto a measurement position of a measurement object from a prescribed angle;

an image acquiring optical system for capturing an image by viewing the measurement position of the measurement object and a surrounding region from an angle different from that of the measurement light emitting optical system; and

a two dimensional imaging device for photoelectrically converting an image obtained by the image acquiring optical system into a video signal corresponding to the image;

the controller being adapted to control an imaging condition associated with a brightness of the image in the form of the video signal, and to operate under a measurement mode and an observation mode;

when the controller operates under the measurement mode, with a light source for measurement turned on, the imaging condition being adjusted in such a manner that a measurement light radiated light image can be imaged at an appropriate brightness but a surrounding part of the measurement object is substantially darker than the appropriate brightness, and a desired displacement being computed according to the video signal obtained by the two dimensional imaging device;

when the controller operates under the observation mode, the imaging condition being adjusted in such a manner that the measurement position and the surrounding part of the measurement object can be imaged both at an appropriate

brightness, and an image of the measurement position on the surface of the measurement object and the surrounding region being displayed on the screen of an image monitor according the video signal obtained by the two dimensional imaging device.

2. A displacement sensor according to claim 1, wherein the imaging condition which is adjusted under the measurement mode includes the brightness control for the measurement light source and/or exposure time for the two dimensional imaging device.

3. A displacement sensor according to claim 1, wherein the controller under the observation mode is adapted to adjust the imaging condition in such a manner that the measurement light radiated light image is not imaged at all or substantially darker than the appropriate brightness.

4. A displacement sensor according to claim 3, wherein the imaging condition which is adjusted under the observation mode includes a turned on or turned off state of the measurement light source, the brightness control for the measurement light source and/or the exposure time for the two dimensional imaging device.

5. A displacement sensor according to claim 1, wherein the controller under the observation mode is adapted to adjust the imaging condition in such a manner that the measurement light source is turned on, and the measurement light radiated light image and the surrounding region are both imaged at an appropriate brightness.

6. A displacement sensor according to claim 5, wherein the imaging condition which is adjusted under the observation mode includes the brightness control for the measurement light source and/or the exposure time for the two dimensional imaging device.

7. A displacement sensor according to claim 1, wherein the observation mode

includes a first observation mode and a second observation mode, the controller under the first observation mode adjusting the imaging condition in such a manner that a measurement light radiated light is not imaged at all or imaged substantially darker than an appropriate brightness, the controller under the second observation mode adjusting the imaging condition in such a manner that with the measurement light source turned on, and the measurement light radiated light image and the surrounding part of the measurement object can be both imaged at an appropriate brightness.

8. A displacement sensor according to claim 1, wherein the controller under the observation mode is adapted to repeatedly carry out one or a plurality of shots under the imaging condition where a measurement light radiated light image is not imaged at all or imaged substantially darker than an appropriate brightness, and one or a plurality of shots under the imaging condition where with the measurement light source turned on, and a measurement light radiated light image is imaged at an appropriate brightness but a surrounding surface of the measurement object is imaged substantially darker than an appropriate brightness, in an alternating manner.

9. A displacement sensor according to claim 8, wherein the controller is adapted to display the obtained image every time on the image monitor.

10. A displacement sensor according to claim 8, wherein the controller is adapted to display two images obtained under different imaging conditions one over the other on the image monitor.

11. A displacement sensor according to claim 1, wherein the controller is adapted to repeatedly carry out one or a plurality of shots under the measurement mode and one or a plurality of shots under the observation mode, in an alternating manner.

12. A displacement sensor according to claim 11, wherein the controller is adapted not to display an image obtained under the measurement mode but display an image obtained under the observation mode.

13. A displacement sensor according to claim 11, wherein the controller is adapted to display one of an image obtained under the measurement mode or an image obtained under the observation mode in a selective manner.

14. A displacement sensor according to any one of claims 1 to 12, wherein further comprising an illuminator for illuminating a measurement position on the measurement object and a surrounding region, the controller being adapted to turn on the illuminator under the observation mode.

15. A displacement sensor according to claim 14, wherein the imaging condition under the observation mode includes a brightness of the illuminator.

16. A displacement sensor according to any one of claims 1 to 13, wherein the image acquiring optical system comprises an oblique image acquiring optical system for capturing an image by viewing the measurement position of the measurement object and a surrounding region from an oblique angle, and a frontal image acquiring optical system for capturing an image by viewing the measurement position of the measurement object and the surrounding region from the front; and

the two dimensional imaging device comprises a two dimensional oblique image imaging device for photoelectrically converting an image obtained via the oblique image acquiring optical system and a two dimensional frontal image imaging device for photoelectrically converting an image obtained via the frontal image acquiring optical system;

the controller under the measurement mode being adapted to compute a desired displacement according to a video signal from the two dimensional oblique

image imaging device while the controller under the observation mode is adapted to display the measurement point of the measurement object and the surrounding region according a video signal from the two dimensional frontal image imaging device.

17. A displacement sensor according to claim 16, wherein the controller is additionally adapted to operate under an image processing mode for computing a length or area on a surface of the measurement object by suitably adjusting a magnification factor of an image obtained by the frontal image acquiring optical system according a displacement computed from an oblique image obtained by the oblique image acquiring optical system.

18. A displacement sensor according to any one of claims 1 to 13, wherein the image acquiring optical system comprises an oblique image acquiring optical system for capturing an image by viewing the measurement position of the measurement object and a surrounding region from an oblique angle, and a frontal image acquiring optical system for capturing an image by viewing the measurement position of the measurement object and the surrounding region from the front;

the two dimensional imaging device is used commonly for the two image acquiring optical systems.

19. A displacement sensor according to claim 18, wherein the two dimensional imaging device is placed at an intersection of light paths of the frontal image acquiring optical system and the oblique image acquiring optical system.

20. A displacement sensor according to claim 19, wherein an exit light axis of the measurement light emitting optical system and an incident light axis of the oblique image acquiring optical system are arranged symmetrically at a same inclination angle, and the two dimensional imaging device is placed on an extension of an incident light axis of the frontal image acquiring optical system, the oblique

image acquiring optical system comprising a light axis refracting mechanism for refracting an incident light axis onto the two dimensional imaging device.

21. A displacement sensor according to claim 20, wherein the light axis refracting mechanism is adapted in such a manner that light images formed on a light receiving surface of the two dimensional imaging device via the oblique image acquiring optical system and via the frontal image acquiring optical system move in a same direction on the light receiving surface of the two dimensional imaging device for a given change in the measurement displacement.

22. A displacement sensor according to claim 18, further comprising shutter means for selectively shutting off one of a first light path reaching the imaging device via the oblique image acquiring optical system or a second light path reaching the imaging device via the frontal image acquiring optical system either manually or electrically, so that the light path for the frontal image acquiring optical system is shut off under the measurement mode and the light path for the oblique image acquiring optical system is shut off under the observation mode.

23. A displacement sensor according to claim 18, further comprising:

an illuminator for illuminating a measurement position of a measurement object and a surrounding region;

a first optical filter having a band pass property for substantially permitting the passage of the measurement light provided in a first light path reaching the imaging device via the oblique image acquiring optical system; and

a second optical filter having a band pass property for substantially permitting the passage of the illuminating light provided in a second light path reaching the imaging device via the frontal image acquiring optical system;

the controller under the observation mode being adapted to turn on the

illuminator.

24. A displacement sensor according to claim 18, wherein the controller is additionally adapted to operate under an image processing mode for computing a length or area on a surface of the measurement object by suitably adjusting a magnification factor of an image obtained by the frontal image acquiring optical system according a displacement computed from an oblique image obtained by the oblique image acquiring optical system.

25. A sensor head for an optical displacement sensor comprising:

a measurement light emitting optical system for emitting measurement light onto a measurement position of an measurement object from a prescribed angle;

an oblique image acquiring optical system for capturing an image by viewing the measurement position of the measurement object and a surrounding region from an oblique angle;

a frontal image acquiring optical system for capturing an image by viewing the measurement position of the measurement object and the surrounding region from the front; and

a two dimensional imaging device for photoelectrically converting an oblique image obtained by the oblique image acquiring optical system and a frontal image obtained by the frontal image acquiring optical system into a video signal corresponding to the images.

26. A sensor head for an optical displacement sensor according to claim 25, wherein the two dimensional imaging device is placed at an intersection of light paths of the frontal image acquiring optical system and the oblique image acquiring optical system.

27. A sensor head for an optical displacement sensor according to claim 26,

wherein an exit light axis of the measurement light emitting optical system and an incident light axis of the oblique image acquiring optical system are arranged symmetrically at same inclination angle, and the two dimensional imaging device is placed on an extension of an incident light axis of the frontal image acquiring optical system, the oblique image acquiring optical system comprising a light axis refracting mechanism for refracting an incident light axis onto the two dimensional imaging device.

28. A sensor head for an optical displacement sensor according to claim 27, wherein the light axis refracting mechanism is adapted in such a manner that light images formed on a light receiving surface of the two dimensional imaging device via the oblique image acquiring optical system and via the frontal image acquiring optical system move in a same direction on the light receiving surface of the two dimensional imaging device for a given change in the measurement displacement.

29. A sensor head for an optical displacement sensor according to any one of claims 25 to 28, further comprising shutter means for selectively shutting off one of a first light path reaching the two dimensional imaging device via the oblique image acquiring optical system and a second light path reaching the imaging device via the frontal image acquiring optical system in an alternative manner either manually or remotely.

30. A sensor head for an optical displacement sensor according to any one of claims 25 to 28, further comprising an illuminator for illuminating a measurement position of a measurement object and a surrounding region.

31. A sensor head for an optical displacement sensor according to claim 30, further comprising a first optical filter having a band pass property for substantially permitting the passage of the measurement light provided in a first light path

reaching the imaging device via the oblique image acquiring optical system; and

a second optical filter having a band pass property for substantially permitting the passage of the illuminating light provided in a second light path reaching the imaging device via the frontal image acquiring optical system;